between the results obtained for the two sample sizes It may be due to differences in the level of equilibration, or to the use of periodic boundary conditions, or to a combination of both these factors

## 3.4 Conclusions

The following conclusions may be drawn from the results described in the preceding section First, our calculations show that weak pinning disorder of strength similar to that expected for the pinning caused by a few percent concentration of atomic-scale defects (such as Oxygen vacancies) in high-$T_c$ superconductors leads to structures which are very similar to the structures observed in decoration experiments on "clean" samples This observation lends strong support to the contention that the disorder in the vortex structures found in these decoration experiments reflects the presence of a small concentration of atomic scale defects All the qualitative results obtained in decoration experiments about the behaviour of the translational and orientational correlation functions are correctly reproduced in our simulations These qualitative features include a slower decay of the orientational correlation function with separation (in comparison to the decay of the translational correlation function with separation), and a faster growth of the orientational correlation length as the relative strength of the disorder is decreased Secondly, our simulations show that a fast quench from a high temperature generates metastable states with higher energy, larger concentration of topological defects and shorter translational and orientational correlation lengths Local energy minima with lower energy and a higher degree of positional and orientational order are obtained when the system is annealed at a temperature lower than the melting temperature of the pure system This observation resolves a controversy about the interpretation of the results of decoration and neutron scattering experiments on high-$T_c$ superconductors Finally, our results are consistent with a theoretical prediction about the proportionality of the square of the translational correlation length (measured in units of the average lattice spacing) with the orientational correlation length measured in the same unit Since the same theory also predicts that the orientational correlation function decays exponentially whenever dislocations are present (an exponential decay of the correlation function is, of course, necessary for the definition of a correlation length), our results provide strong support to the contention that a "hexatic glass" phase with long-range or quasi-long-range orientational order does not exist if disorder-induced dislocations are present in the system

We do not find any evidence for the "Bragg glass" phase predicted in recent theories [29, 30] of the structure of a randomly pinned elastic manifold This is not surprising because all the structures generated in our simulations have dislocations, whereas the theoretical predictions of Ref [29, 30] apply to structures without any topological defect Our results suggest that a weaker pinning potential must be used in order to generate energy minima without any dislocation It may, however, be difficult to detect subtle effects of such weak disorder in numerical studies of small systems

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